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The Negative Consequences of Using Free and Reduced Lunch as a Measure of School-Level Poverty: A Case from the State of Georgia

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Abstract

Poverty has long been known to be strongly correlated with academic achievement. The Federal Government, the State of Georgia, and many other states have adopted the policy of reporting school-level poverty by the percentage of students receiving free and reduced lunch. However, as we show in this article, there is a severe restriction of range in the upper end of the free and reduced lunch variable. This restriction in range can result in schools with ostensibly equal levels of free and reduced lunch percentages having levels of poverty that vary to a great degree. This can result in the systemic misallocation of resources from the schools with the most need and the miscalculation of value-added accountability estimates. The purpose of this study is to illustrate this phenomenon with recent pre-existing CRCT and free and reduced lunch data from over 1,200 elementary schools in the State of Georgia.

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According to the U.S. Census Bureau (2011), in 2010, nearly one in four children in Georgia live in poverty; this percentage tends to be getting worse over time (Annie E. Casey Foundation, 2014). Furthermore, this percentage tends to be greater for minorities (U.S. Census Bureau, 2011); nearly one in three African American children and nearly 40% of Hispanic children live in poverty.

Besides the mental and physical toll that poverty takes on children (Feinstein, 1993; Murali & Oyebode, 2004), poverty has long been known to be strongly correlated with academic achievement (Duncan & Brooks-Gunn, 1997; White, 1986). White found that the correlation between socioeconomic status and academic achievement is as high as .71 when using the school as the unit of analysis. Some educational historians have even questioned whether successful school reform can occur without complementary economic and political policies reforms (Anyon, 1997, Ravitch, 2010)

Given the strength of the relationship between poverty and academic achievement, it is no surprise that there is debate about the best way to measure school-level poverty. Of the many ways to measure it, the percentage of students who receive free and reduced lunch is the method most commonly used (Kurki, Boyle, & Aledjem, 2005). In intercensal years, even the National Academy of Sciences recommends using percent of free and reduced lunch (FRL) as a measure of poverty in educational systems (Cruse & Powers, 2006). The Federal Government, the State of Georgia, and many other states have adopted this policy in reporting school-level poverty

While free and reduced lunch is a popular method for measuring poverty, it is not without its critics. Cruse and Powers (2006) argue that the median prediction error for

estimating district poverty estimates from free and reduced lunch rates are much too high. Cruse and Powers compared U.S. Census Bureau data with data from the National Center for Educational Statistics' Public Elementary/Secondary School Universe Survey (National Center for Educational Statistics, 2006). They found that the median prediction error for estimating U.S. family income data from free and reduced lunch data was as great as 30%.

Kurki, Boyle, and Aledjem (2005) found moderate and statistically significant correlations between free and reduced lunch and other alternate measures of poverty (e.g., the Dissimilarity Index, the Isolation Index ,and others). They argue that free and reduced lunch can approximately estimate the proportion of students living in poverty, but that it neglects other dimensions of poverty, such as neighborhood effects.

In this article, we expand on the earlier research of Cruse and Powers (2006) and Kurki, Boyle, and Aledjem (2005). Instead of examining the influence of neighborhood effects or prediction errors for estimating poverty in districts, we explore one possible cause for the prediction errors in free and reduced lunch poverty estimates. We hypothesize there is a severe restriction of range in the upper end of the free and reduced lunch variable. This restriction in range can result in schools with ostensibly equal levels of free and reduced percentages having levels of poverty that vary to a great degree. For example, two schools with the same percentage of students receiving free and reduced lunch might have very different median family incomes. This can result in the systemic misallocation of resources from the schools with the most need and the miscalculation of value-added accountability estimates. The purpose of this study is to illustrate this phenomenon with recent pre-existing CRCT and free and reduced lunch data from over 1,200 elementary schools in the State of Georgia.

Methods

These data were collected as part of a larger dissertation research study done by Prejean-Harris (2013). Therefore, more detailed information on the variables and data collection can be found there.

Participant Characteristics

The data consisted of information on 1,244 elementary schools from 191 districts for the 2012-2013 school year. In particular, we concentrated on data from the third grade. According to the Georgia Department of Education (2012b), there were 128,702 third-grade students in Georgia for the 2011-2012 school year. Of those third-grade students, 4% were Asian, 36% were Black, 14% were Hispanic, 3% were multiracial, and 46% were White. In the data we used here, the mean third-grade mathematics CRCT score was 838.06 with 95% confidence intervals of 836.88 and 839.24. The third-grade mean science CRCT score was 830.74 with 95% confidence intervals of 829.59 and 831.89. The percentage of students receiving free or reduced lunch was 63.20 with 95% confidence intervals of 61.79 and 64.60. Of the 1,244 schools, 238 were classified as being in urban settings.

Data Collection

Data on academic achievement (CRCT scores) for each public school was collected from the Georgia Department of Education (GADOE) and were publically available on the agency's website. Information on percentages of free and reduced lunch were collected from the National Center for Educational Statistics. The two data sets were merged by using school codes as a key variable.

Measure and Covariates

Georgia Criterion-Referenced Competency Test (CRCT)—Third grade mathematics and science. The CRCT is a standardized test administered in Georgia to measures students' proficiency in the Georgia Performance Standards in English, reading, mathematics, science, and social studies. In this study, we used 2011-2012 CRCT scale scores in reading and mathematics for third-grade students. According to the GADOE (2012b) the values of Cronbach's α for mathematics and science were .92 and .91 with standard errors of 2.92 and 3.19 respectively. The Georgia Department of Education (2012a) claims the test has sufficient content validity because of its development being carefully based on clear and measurable standards.

Free or reduced lunch. Free and reduced lunch was a continuous variable in this study reported as the percentage of students eligible for free or reduced meals. According to the U.S. Department of Agriculture, the eligibility for free and reduced meals was "obtained by multiplying the 2011 Federal income poverty guidelines by 1.30 and 1.85, respectively, and by rounding the result upward to the next whole dollar" (2013, p. 16724). In 2011, a family of four whose annual income was $22,350 or less was considered to be in poverty. A family of four whose annual income was $44,348 or less was eligible for reduced lunch; a family of four whose annual income was $29,055 or less was eligible for free lunch (U.S. Department of Agriculture, 2013).

Research Design and Data Analysis

This was a descriptive and correlational quantitative study. Data were analyzed through correlational and regression analyses and visual analyses of histograms and scatterplots. The school was the unit of analysis

Results

In this section, we present evidence for a restriction of range between CRCT scores and FRL. We then explore the cause for this restriction of range by examining the distributions of the CRCT and FRL variables.

Relationship between CRCTs and FRL

Figure 1 is a scatterplot of third-grade mathematics CRCT scores and percentage of free and reduced lunch in 1,244 Georgia schools. The scatterplot was markedly linear and the negative correlation was large and statistically significant, $r(1244) = -.80$, $p < .001$. The percent of variance accounted for in the model (i.e., R^2) was .64. Essentially, schools with more students receiving free and reduced lunch strongly tended to have lower CRCT scores. The results of a regression analysis showed that the third-grade math CRCT scores decreased by 0.67 points ($SE = 0.01$) for every 1% increase in the percentage of students receiving free and reduced lunch (CRCT intercept = 880.68). What we find most interesting about this scatterplot is that there was a marked restriction in range in the lower right part of the scatterplot. The data appeared to be censored (i.e., they appeared to be hitting a wall) in the lower right region.

The results were very similar for the relationship between science CRCT scores and FRL (see Figure 2). Again the scatterplot was linear and there was a large and statistically significant negative correlation, $r(1244) = -.83$, $p < .001$. The percent of variance accounted for in the model (i.e., R^2) was .68. The results of a regression analysis showed that the third-grade science CRCT scores decreased by 0.68 points ($SE = 0.01$) for every 1% increase in the percentage of students receiving free and reduced lunch (CRCT intercept = 873.46). The same restriction in range in the lower right section of the scatterplot was also present in Figure 2.

Normality of CRCT Scores

To explore the possible cause for the restriction in range between CRCT and FRL, we first examined the distribution of the third-grade math and science CRCT scores. Figures 3 and 4 show the distributions of third-grade mathematics and science CRCT scores, respectively. Those figures show that both the third-grade mathematics and science CRCT scores, although perhaps leptokurtotic, appeared to have little to no skew. Most importantly, note that there was no restriction in range.

Normality of Free or Reduced Lunch Percentages

Figure 5 is a histogram of the percentage of third-grade students receiving free or reduced lunch in Georgia elementary schools. Figure 5 shows that there was a very severe restriction in range; the scores seemed to be censored on the right side for schools with high percentages of students receiving free or reduced lunch. This restriction of range has serious consequences for research and policy decisions as we discuss in the next section.

Discussion

In essence, what we have shown thus far is that there is a strong relationship between the percentage of students receiving free and reduced lunch and academic achievement. Those results were similar to estimates in the past research. White (1986) found that the correlation between free or reduced lunch and academic achievement was .71; we found slightly higher values of .80 for mathematics and .83 in science. The finding that we want to stress in this article, however, is that *we found a marked restriction in range in the relationship between academic achievement and the percentage of students receiving free and reduced lunch, which is the most commonly used variable in education research and policy used as a proxy for poverty.*

To explore the causes of the restriction in range, we examined the distributions of CRCTs and the percentage of students receiving free or reduced lunch within a school. We found that

CRCTs had no restriction in range but the free or reduced lunch variable had a very severe restriction in range for schools with a high percentage of students receiving free or reduced lunch.

Implications

The implications of this restriction in range are severe. In terms of economic policy, schools receive federal, state, or nonprofit resources based on the poverty level of the students they serve through Title 1 and other sources of funding. However, when free or reduced lunch is used as a proxy for poverty, the restriction in range causes slightly impoverished schools to appear to be as impoverished as severely impoverished schools. This phenomenon might be best illustrated through a thought experiment.

First, imagine a school where 95% of students' family's annual income is about $45,000 ($44,348 or less was the family-of-four annual income cut-off point for students receiving *reduced-cost meals* in 2011). Let us call this School A. Imagine what resources that school would need to overcome the challenges of serving its impoverished children and families.

Second, imagine a school where 95% of students' family's annual income is about $30,000 ($29,055 or less was the family-of-four annual income cut-off point for students receiving free meals in 2011). Let us call this School B. Imagine what resources that school would need to overcome the challenges of serving its impoverished children and families.

Finally, imagine a school where 95% of students' family's annual income is about $5,000. Let us call this School C. Imagine what resources that school would need to overcome the challenges of serving its impoverished children and families.

Now, if educational policy makers and researchers use the percentage of free and reduced lunch as the only measure of a school population's poverty level, School A, B, and C would be

considered equally impoverished because they would all be schools in which 95% of students received free or reduced lunch. What is especially egregious is that since schools get financial, material, or professional resources allotted to them based partially on the poverty level of the students they serve, School A, B, and C would get the same additional resources to help their students of poverty overcome their challenges if free and reduced lunch is the only measure of poverty. However, it is clear that School C (the $5000 family-annual-income school) is desperately more in need and more deserving of additional resources than School A (the $45,000 family-annual-income school). Despite the injustices mentioned above, free and reduced lunch is still used as the primary measure of a school population's measure of poverty, as discussed in the introductory section.

There are also implications for the hotly debated topic of value-added models of school accountability (Ravitch, 2010). For example, from the regression results presented in the Results section, when adjusting for a school's percentage of free and reduced lunch, the value-added CRCT mathematics projection would be an 817.03 for School A, B, and C (i.e, 880.68 - .67 * 95). The problem is that because of the restriction of range, School C would be expected to have as much academic achievement as School A, although School C's students are severely more impoverished. Again, an educational injustice would be committed if this were the case; both schools would be held equally accountable for meeting their projected CRCT score of 817.03, while School C school population was much more impoverished.

Recommendations

The conspicuous recommendation is for educational policy makers and researchers to not use free and reduced lunch as the sole measure of school-level poverty and to use it for what it was meant for—to decide which students should be eligible to receive free or reduced lunch. The

most obvious recommendation would be to collect data on actual family income and consider it as a continuous variable or a categorical variable with a sufficient number of income categories. This would avoid the restriction of range problem discussed above and, therefore, could lead to a more equitable distribution of educational resources. It might also lead to insights such as discovering skew, kurtosis, or multiple modes and have more statistical conclusion validity. Kurki, Boyle, and Aledjem (2005) provide a number of alternate measures that take into account neighborhood effects. Cruse and Powers (2006) and Maples and Bell (2005) also provide alternative strategies for estimating poverty levels in a school or district.

Because poverty is such an important covariate in educational models related to academic achievement, we recommend including poverty as a covariate in educational models, however, even if the only choice is using free and reduced lunch. We understand that many times the only measure of a school population's poverty reported by federal or state agencies is percentage of free and reduced lunch. *In that case, however, we recommend adding the restriction of range phenomenon as a study limitation and clearly explaining its implications to readers.*

Summary

In summary, in this investigation we showed that the free and reduced lunch variable, which is so often used in educational policy and research, has a marked restriction in range that censors schools that have student populations with high levels of poverty. As a result, using this variable as the sole measure of school-level poverty has serious negative consequences in terms of the equitable allocation of resources and for value-added estimated of school accountability. Clearly, poverty is a very important predictor in modeling a school's academic achievement and we recommend taking it into account educational models. However, we recommend that

educational researchers and policy makers avoid using percentage of free and reduced lunch as the sole measure of poverty and to use it cautiously when it cannot be avoided

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Figures

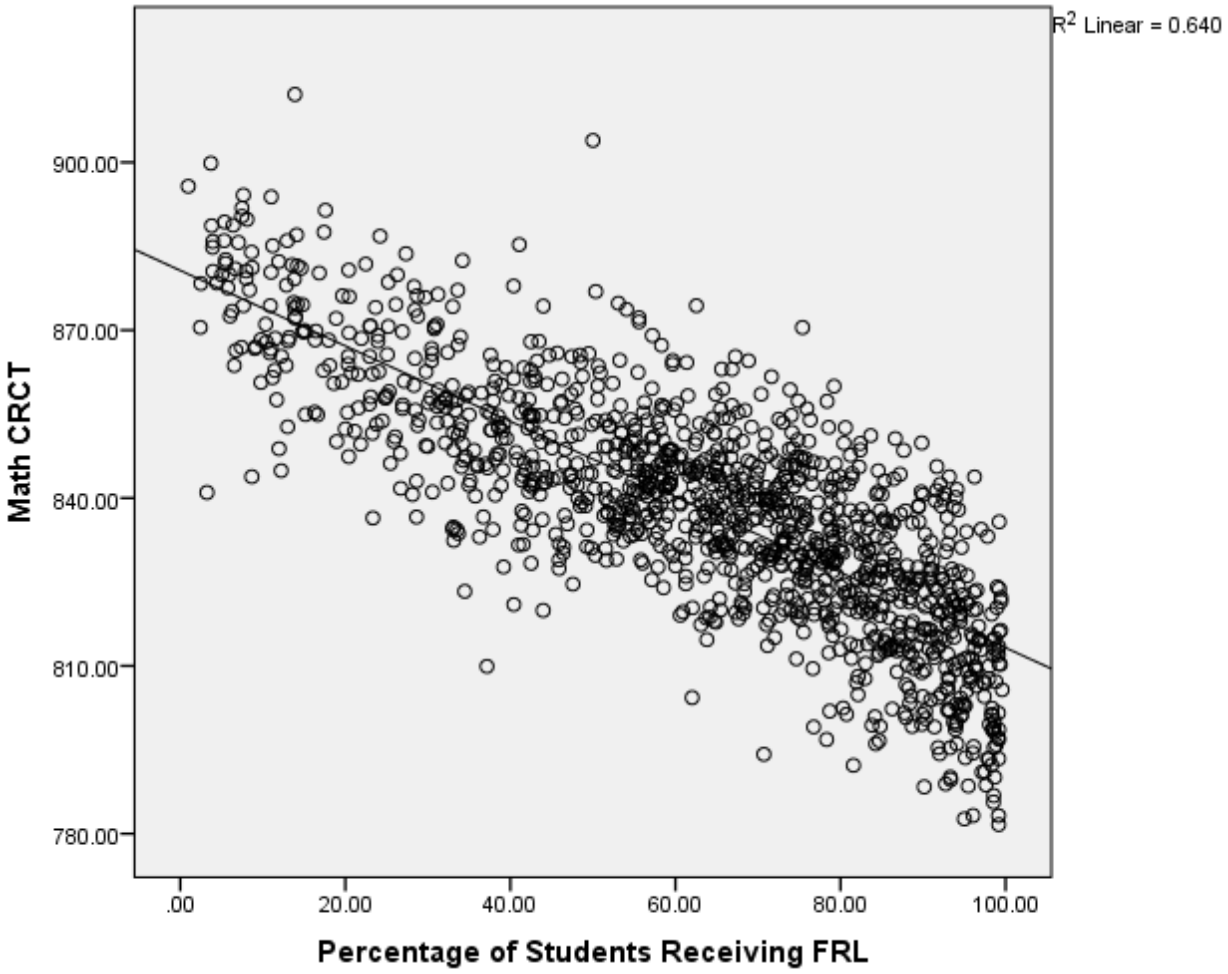

Figure 1. Scatterplot of mathematics CRCT scores and percentage of students receiving free or reduced lunch, with line of best fit included. CRCT = Criteria-Reference Competency Test, FRL = free and reduced lunch.

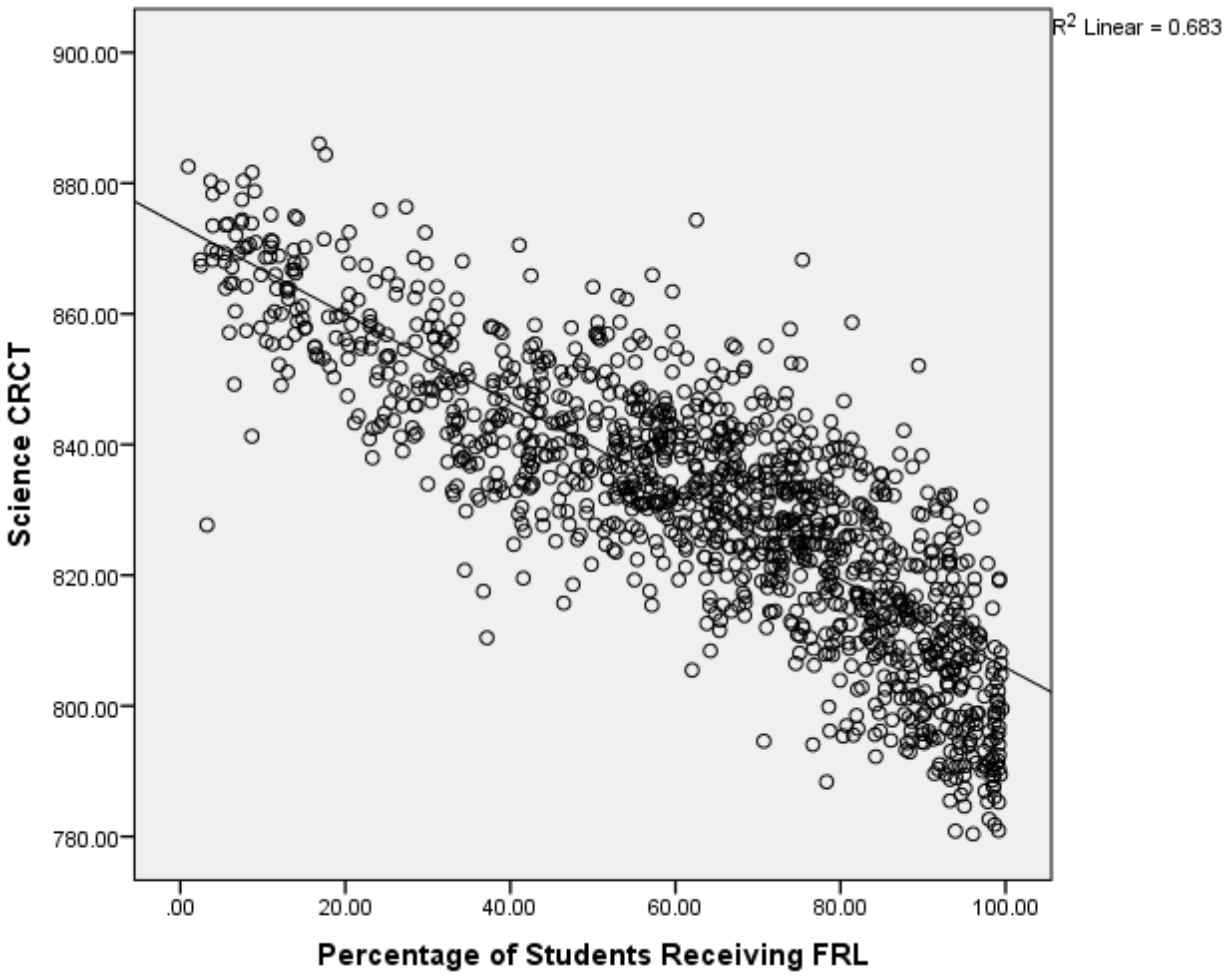

Figure 2. Scatterplot of science CRCT scores and percentage of students receiving free or reduced lunch, with line of best fit included. CRCT = Criteria-Reference Competency Test, FRL = free and reduced lunch.

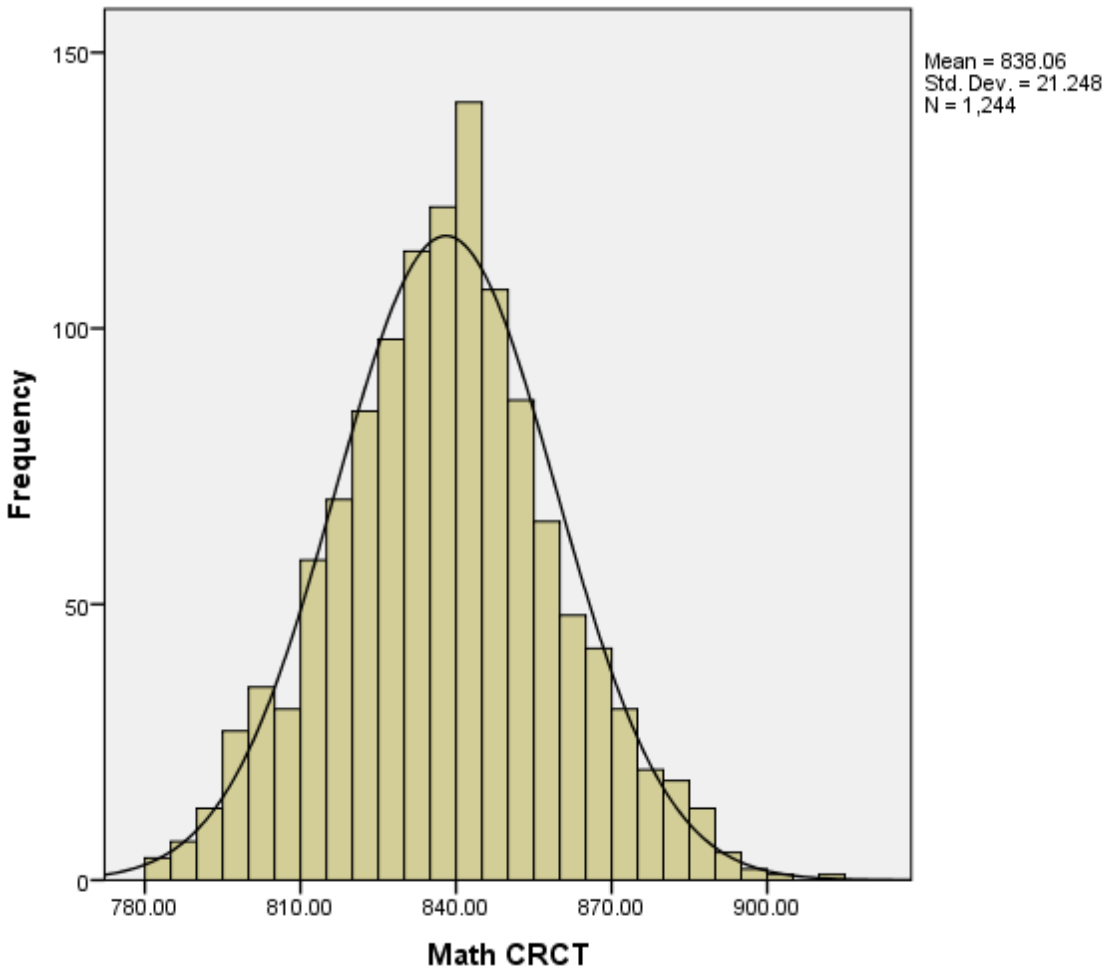

Figure 3. Histogram of mathematics CRCT scores.

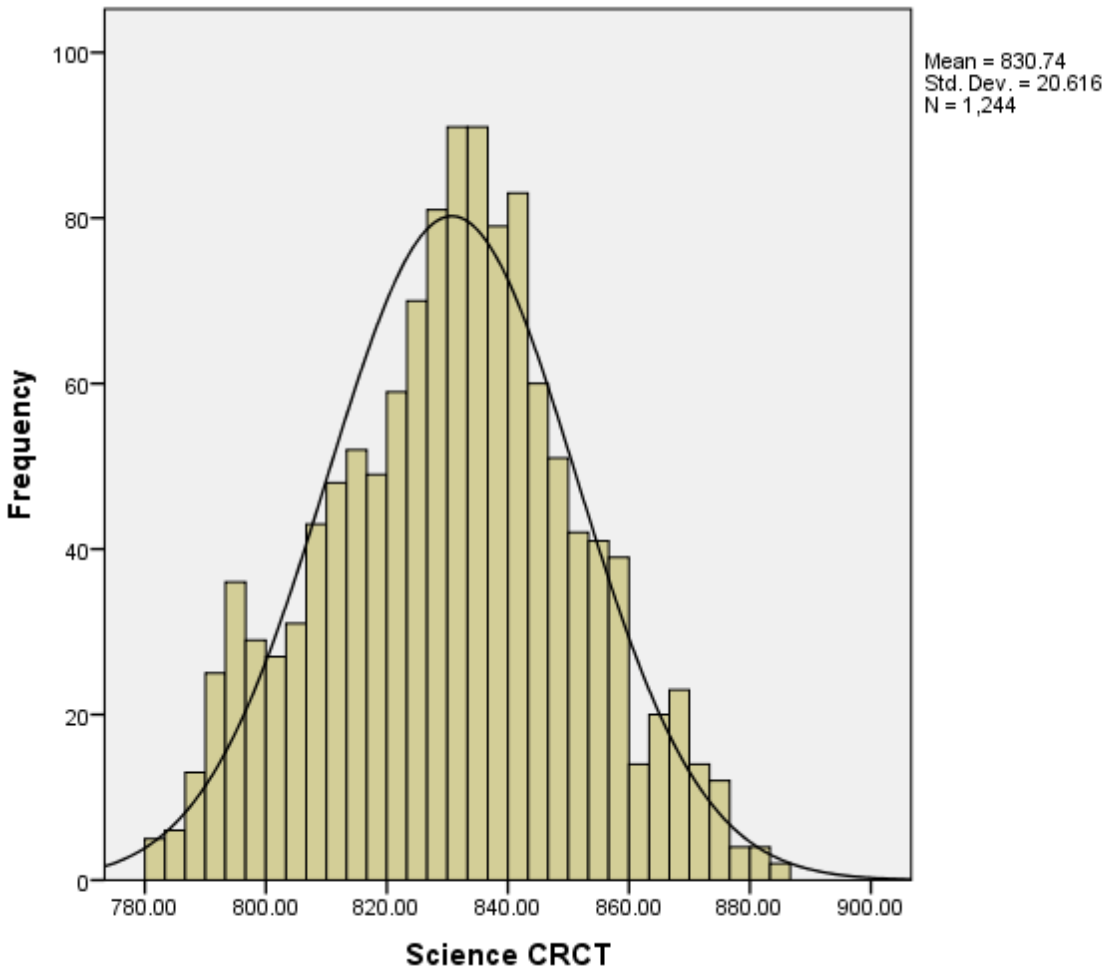

Figure 4. Histogram of science CRCT scores.

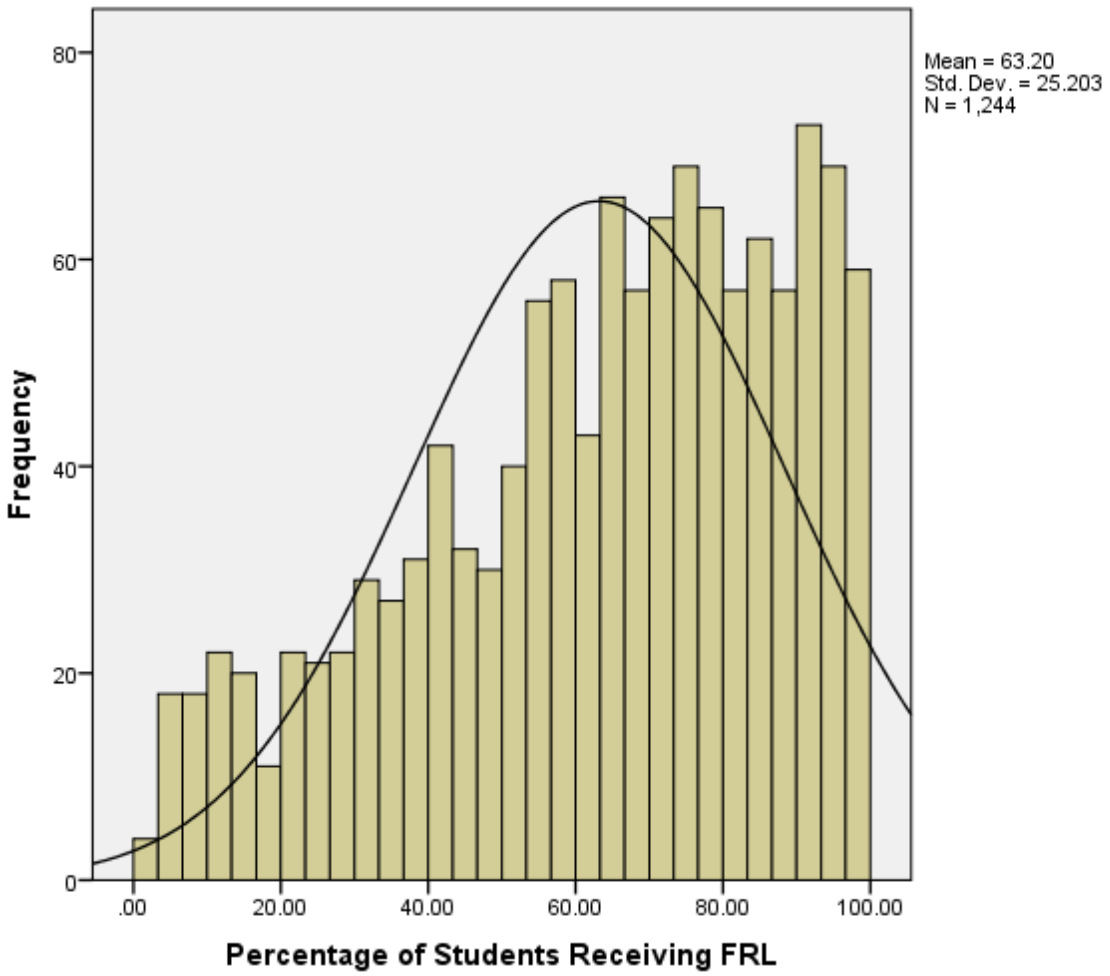

Figure 5. Histogram of percentages of third-grade students receiving free or reduced lunch in Georgia elementary schools.